



Effect of Dietary Incorporation of *Moringa oleifera* Leaf Meal on Biochemical Parameters of Japanese Quail

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ABSTRACT: A feeding trial was conducted to discern the influence of dietary incorporation of *Moringa oleifera* leaf meal on biochemical parameters of Japanese quail. A total 288 day-old Japanese quail chicks were randomly distributed into eight treatments of 36 Japanese quail chicks per treatment with three replicates of 12 quail in each. Japanese quail of treatment T₁ (control group) were fed a basal diet (starter and finisher), whereas in treatment group T₂ basal diet was incorporated with Vitamin C @200 mg/kg, T₃ basal diet was incorporated with Vitamin E @10 IU/kg, and in diets T₄, T₅, T₆, T₇, and T₈, the basal diet was incorporated with 1.0%, 3.0%, 5.0%, 7.0% and 9.0% *Moringa oleifera* leaf meal, respectively. Results showed that significantly ($P \leq 0.05$) reduced serum glucose, serum cholesterol, serum triglycerides, serum LDL, serum VLDL cholesterol, alkaline phosphatase and serum creatinine concentration in Japanese quail fed diet with 3.0% *Moringa oleifera* leaf meal. Significantly ($P \leq 0.05$) improved serum HDL, serum calcium, serum phosphorus level of Japanese quail fed diet with 3.0% *Moringa oleifera* leaf meal as compared to control. Non-significant ($P \geq 0.05$) effects on serum uric acid (mg/dl) and serum total protein concentration were observed when Japanese quails fed diet with different levels of *Moringa oleifera* leaf meal. It can be concluded that 3.0% *Moringa oleifera* leaf meal can be incorporated in feed for improvement in lipid profile, liver function enzyme of Japanese quail.

Keywords: Biochemical parameters, Japanese quail, *Moringa oleifera* leaf meal.

INTRODUCTION

Poultry production stands as a dynamic sector within agriculture, rapidly expanding to meet the diverse demands of global population. The 20th livestock census of 2019 revealed a substantial poultry population in India, totaling 851.81 million birds. Commercial quail farming is becoming more popular and is being increasingly promoted in number of Asian and European countries and in Africa (RSPCA, 2011). The quail, also known as "bater" in hindi, is a small bird that belongs to the family Phasianidae, genus *Coturnix* and species *coturnix japonica*. Quail meat and eggs have garnered attention for their nutritional richness, boasting abundant antioxidants, proteins, minerals and of vitamins, as documented by Bao *et al.* (2020). National Research Council (NRC) in 1994 emphasized that quails necessitate a higher protein intake compared to chickens, further highlighting the nutritional significance of quail-derived products in meeting consumer demands for diverse and nutrient-dense protein sources. Due to increased demand for protein sources, there is need to check for an alternative

which is available locally with higher protein percentages.

In pursuit of cost-effective protein sources for poultry nutrition, the leaf meal derived from the tropical browse plant, *Moringa oleifera*, emerges as a promising candidate. Renowned for its robust nutritional profile, *Moringa oleifera* leaf meal contains substantial levels of crude protein ranging from 25% to 30%, alongwith essential amino acids, minerals, carotenoids, and vitamins (Nkukwana *et al.*, 2014; Lu *et al.* 2016). The current study was conducted to evaluate the effect of dietary incorporation of *Moringa oleifera* leaf meal on biochemical parameters of Japanese quail.

MATERIALS AND METHODS

A. Experimental Location, Birds and Management

The present study was conducted to discern the effect of dietary incorporation of *Moringa oleifera* leaf meal on biochemical parameters of Japanese quail. The entire study was conducted at Instructional Poultry Farm (I.P.F.) and Department of Animal Nutrition, College of Veterinary and Animal Sciences, G.B. Pant

University of Agriculture and Technology, Pantnagar located at latitude of 28°53'24" North, longitude of 77°34'27" East at an altitude of 243.84 meters above Mean Sea Level.

For this experimental trial, two hundred and eighty eight (288 Nos.), day-old Japanese quail chicks were hatched and reared at Instructional Poultry Farm (I.P.F), Nagla, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. Each treatment comprised of three replicates consisting of 12 Japanese quails per replicate. Japanese quail were reared in a cage system using standard management and health care practices. The quail chicks were fed *ad libitum* feed and had access to clean and fresh water in suitable troughs to all quail chicks during the experimental feeding trial. For the experiment, two types of basal diets were prepared to meet the nutrient requirement of Japanese quail, *i.e.*,

starter (0-3 weeks) and finisher (3-6 weeks) as per ICAR (2013). The eight dietary treatments were T₁ (Basal diet), T₂ (Basal diet with vitamin C @ 200 mg/kg), T₃ (Basal diet with vitamin E @ 10 IU/kg), T₄ (Basal diet with 1% MOLM), T₅ (Basal diet with 3% MOLM), T₆ (Basal diet with 5% MOLM), T₇ (Basal diet with 7% MOLM) and T₈ (Basal diet with 9% MOLM). Blood samples were collected for biochemical analysis on the 42 day of the experiment.

B. Statistical Analysis

Statistical analysis was done using SPSS software.

RESULTS AND DISCUSSION

Serum protein profile: The mean values of serum protein profile *viz.*, total protein, albumin, globulin and A/G ratio are given in Table 1.

Table 1: Average values of serum protein profile in Japanese quail at 6 weeks of age fed diets incorporated with *Moringa oleifera* leaf meal.

Attributes	Treatments								SEm	P- Value
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈		
Total protein (g/dl)	6.72±0.06	6.74±0.07	6.76±0.09	6.99±0.05	7.09±0.02	7.14±0.03	6.80±0.07	6.95±0.25	0.045	0.070
Albumin (g/dl)	3.98±0.01	3.92±0.39	3.96±0.05	3.92±0.03	3.88±0.02	3.85±0.01	4.09±0.31	4.07±0.40	0.069	0.994
Globulin (g/dl)	2.74±0.06	2.81±0.46	2.79±0.15	3.07±0.02	3.21±0.01	3.28±0.03	2.71±0.38	2.88±0.34	0.085	0.626
A/G ratio	1.45±0.03	1.52±0.41	1.42±0.09	1.27±0.01	1.21±0.01	1.17±0.01	1.61±0.38	1.47±0.28	0.073	0.828

Serum total protein. The mean serum total protein values were observed as 6.72±0.06, 6.74±0.07, 6.76±0.09, 6.99±0.05, 7.09±0.02, 7.14±0.03, 6.80±0.07 and 6.95±0.25 (g/dl) for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ treatment groups respectively. Non-significant (P≥0.05) effect on mean serum total protein values was observed when Japanese quail were fed diet with various levels of *Moringa oleifera* leaf meal.

Serum albumin. The mean serum albumin values were noticed as 3.98±0.01, 3.92±0.39, 3.96±0.05, 3.92±0.03, 3.88±0.02, 3.85±0.01, 4.09±0.31, and 4.07±0.40 (g/dl) for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ dietary treatment group respectively. Non-significant (P≥0.05) effect on mean serum albumin values was observed when Japanese quail were fed diet with various levels of *Moringa oleifera* leaf meal.

Serum globulin. The mean serum globulin values were recorded as 2.74±0.06, 2.81±0.46, 2.79±0.15, 3.07±0.02, 3.21±0.01, 3.28±0.03, 2.71±0.38, and 2.88±0.34 (g/dl) for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ dietary treatment group respectively. Non-significant (P≥0.05) effect on mean serum globulin values was observed when Japanese quail were fed diet with various levels of *Moringa oleifera* leaf meal.

Albumin/ Globulin ratio. Non-significant (P≥0.05) effects on mean A/G ratio was observed when Japanese quail were fed diet with different levels of *Moringa oleifera* leaf meal.

The results showed that mean serum total protein, albumin, globulin and albumin/globulin ratio did not

changed significantly (P≥0.05) with inclusion of *Moringa oleifera* leaf meal (1.0, 3.0, 5.0, 7.0 and 9.0%) in diet of Japanese quail. The results of this study relate the report of Makanjuola *et al.* (2014) as they reported that 0.2%, 0.4% and 0.6% *Moringa oleifera* leaf meal (MOLM) did not influence the serum total protein, albumin, and globulin of broilers. Contrary to the current findings, Meel *et al.* (2022) observed that a significant reduction (P<0.05) in serum biochemical parameters like albumin, globulin and total protein upon *Moringa oleifera* leaf meal supplementation upto 2.0% level in broiler diet. Similarly, Abbas *et al.* (2018) also reported significant reductions (P≤0.05) in serum albumin, globulin and total serum protein concentration of broiler chickens fed MOLM @ 0.25, 0.50, 0.75 and 1.0% as compared to control. Also better albumin (A) to globulin (G) ratio in birds supplemented with MOLM at levels 0.25% and 0.50%. Whereas there was no significant (P≥0.05) difference in A/G ratio between birds fed 0.75%, 1.0% of MOLM and control group. Results of A/G ratio are in line with Yang *et al.* (2006) who reported that the dietary supplementation of MOLM decreases A/G ratio in the serum of broilers.

Serum glucose and serum lipid profile: The mean values of serum glucose(mg/dl) serum lipid profile *viz.*, serum glucose(mg/dl), serum cholesterol (mg/dl), serum triglycerides (mg/dl), serum HDL (mg/dl), serum LDL (mg/dl) and serum VLDL cholesterol level are given in Table 2.

Table 2: Average values of serum lipid profile in Japanese quail at 6 weeks of age fed diets incorporated with *Moringa oleifera* leaf meal.

Attributes	Treatments								SEm	P-Value
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈		
Glucose (mg/dl)	207.17±0.44 ^a	206.84±1.16 ^a	207.51±0.75 ^a	201.84±2.49 ^b	196.07±1.22 ^c	193.33±1.45 ^c	196.33±0.33 ^c	195.70±1.22 ^c	1.220	0.001
Cholesterol	135.34±0.35 ^a	133.40±1.25 ^a	134.74±1.07 ^a	129.74±0.56 ^{ab}	128.41±2.83 ^b	121.07±5.63 ^{ab}	124.40±7.55 ^{ab}	123.74±2.06 ^{ab}	1.498	0.045
Triglycerides	99.48±0.01 ^a	98.78±1.00 ^a	97.77±0.57 ^a	95.48±1.00 ^b	93.81±0.33 ^b	97.71±0.57 ^a	98.37±0.31 ^a	97.51±0.36 ^a	0.401	0.001
HDL	38.05±0.01 ^c	38.11±0.03 ^c	38.12±0.04 ^c	39.27±0.01 ^b	41.57±0.11 ^a	41.07±0.35 ^a	40.77±0.65 ^a	39.43±0.02 ^b	0.280	0.001
LDL	77.39±0.34 ^a	75.54±1.15 ^{abc}	77.06±1.11 ^{ab}	71.37±0.41 ^{abcd}	68.07±3.01 ^{abcd}	60.46±5.37 ^d	63.96±8.14 ^{cd}	64.80±2.03 ^{bcd}	1.674	0.031
VLDL Cholesterol	19.89±0.01 ^a	19.76±0.20 ^a	19.55±0.12 ^a	19.09±0.20 ^b	18.76±0.06 ^b	19.54±0.12 ^a	19.67±0.06 ^a	19.50±0.07 ^a	0.080	0.001

Means with different superscripts (a, b, c, d) in a row differ significantly (P ≤ 0.05) from each other

Serum glucose. A significant (P ≤ 0.05) difference in average serum glucose level was observed when Japanese quail was fed diet with various levels of *Moringa oleifera* leaf meal. Significantly (P ≤ 0.05) reduced serum glucose level was noticed in T₆ (193.33) group and higher in T₁ followed by T₂ and T₃ treatment group respectively.

Serum cholesterol. The mean serum cholesterol level were recorded as 135.34±0.35, 133.40±1.25, 134.74±1.07, 129.74±0.56, 128.41±2.83, 121.07±5.63, 124.40±7.55, and 123.74±2.06 (mg/dl) for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ treatment group respectively. Significant (P ≤ 0.05) effect on mean serum cholesterol level was observed when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal.

Serum triglycerides. The mean serum triglycerides level was observed significantly (P ≤ 0.05) when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal. Significant (P ≤ 0.05) lower serum triglyceride was in T₅ followed by T₄ treatment group as compared to control group.

Serum HDL. Significant (P ≤ 0.05) effects on mean serum HDL (mg/dl) level was observed when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal. The value for serum HDL (mg/dl) was noticed as 38.05±0.01, 38.11±0.03, 38.12±0.04, 39.27±0.01, 41.57±0.11, 41.07±0.35, 40.77±0.65 and 39.43±0.02 for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ treatment group respectively. Significantly (P ≤ 0.05) higher serum HDL was observed in T₅ followed by T₆ and T₇ treatment group respectively.

Serum LDL. A significant (P ≤ 0.05) effects on mean serum LDL (mg/dl) level was observed when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal. The value for mean serum LDL (mg/dl) was noticed as 77.39±0.34, 75.54±1.15, 77.06±1.11, 71.37±0.41, 68.07±3.01, 60.46±5.37, 63.96±8.14, and 64.80±2.03 for T₁, T₂, T₃, T₄, T₅, T₆, T₇ and T₈ treatment group respectively. Significantly (P ≤ 0.05) higher serum LDL was observed in T₁ and lower in T₆ treatment group respectively.

VLDL Cholesterol. Significantly (P ≤ 0.05) lower serum VLDL Cholesterol concentration was observed in T₅ followed by T₄ treatment group respectively.

In present findings biochemical parameters showed significant (P ≤ 0.05) reduction in serum cholesterol, serum triglycerides, serum LDL, and serum VLDL cholesterol and significant (P ≤ 0.05) improvement in serum HDL with increasing level of MOLM in diet of Japanese quail. It has reported that *Moringa* plants

contain high amount of polyphenols (Moyo *et al.*, 2012) flavonoids, alkaloids and phenolic compounds (Verma *et al.*, 2009). In the current investigation, noteworthy declines in cholesterol and triglyceride concentrations within the blood serum of quail birds are posited to correlate with the aforementioned phytochemical constituents inherent to *Moringa oleifera* leaf meal. In the process of intestinal digestion, cholesterol emerges as a principal constituent of bile acids discharged. Fibrous material envelops these bile acids within the intestine, facilitating their elimination from the body. Consequently, this prompts the organism to extract cholesterol from the bloodstream for bile acid synthesis, consequently mitigating blood cholesterol levels (Olugbemi *et al.*, 2010). Similarly, Abou-Elkhair *et al.* (2020) found that serum glucose, triglyceride and cholesterol content decreased with the increasing level (0.5, 1.0 and 5.0%) of MOLM in the diets of broiler chickens. Likewise Meel *et al.* (2022) found a significant reduction (P ≤ 0.05) in serum glucose, triglyceride in MOLM supplemented group in broilers. Furthermore Abbas *et al.* (2018) showed that serum total cholesterol, LDL and VLDL were significantly (P ≤ 0.05) declined in *Moringa oleifera* leaf meal (0.25, 0.50, 0.75 and 1.0%) treated groups in comparison with the control, whereas, the high density lipoprotein cholesterol (HDL) and triglyceride (TG) concentrations were increased significantly (P ≤ 0.05) when *Moringa oleifera* leaf meal was included in the diets of broilers.

Serum enzymes profile: The mean values of serum enzyme, Alkaline phosphatase (ALP), Alanine amino transferase (ALT) and Aspartate amino transferase (AST) are depicted in Table 3.

Regarding the values of Alanine amino transferase (ALT) and Aspartate amino transferase (AST) did not showed any significant difference in dietary treatments incorporated with *Moringa oleifera* leaf meal in diet of Japanese quail. But significantly (P ≤ 0.05) lower serum values of Alkaline phosphatase (ALP) in different treatment groups.

The present findings are contrary with the report of Divya *et al.* (2014) who reported significantly (P ≤ 0.05) decreased serum alanine amino transferase and serum aspartate amino transferase in broiler chicks with increasing level (0.5, 1.0, 1.5 and 2.0%) of *Moringa* leaf powder feeding. Similarly Meel *et al.* (2022) showed significant reduction (P ≤ 0.05) in alanine amino transferase (ALT) in broiler chicks fed with MOLM as compared to control diet. Likewise Abbas *et al.* (2018)

noticed that alkaline phosphatase (ALP) enzyme activity was significantly decreased in all supplemented

groups with *Moringa oleifera* leaf meal as compared with the control group in birds.

Table 3: Average values of liver function enzyme in Japanese quail at 6 weeks of age fed diets incorporated with *Moringa oleifera* leaf meal.

Attributes	Treatments								SEm	P-Value
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈		
ALT (U/L)	15.74±2.25	13.74±1.74	14.41±1.52	11.74±0.94	10.49±0.37	11.26±0.16	12.41±1.29	13.42±1.39	0.529	0.201
AST (U/L)	107.76±0.95	106.10±1.56	108.10±4.04	106.77±1.13	99.77±2.31	100.10±2.41	103.43±2.43	104.77±3.76	0.985	0.199
ALP (U/L)	83.74±1.37 ^a	83.07±1.21 ^{ab}	82.32±0.36 ^{abc}	80.99±0.52 ^{abcd}	78.34±0.84 ^d	80.01±1.38 ^{bcd}	79.74±0.23 ^{cd}	80.68±1.06 ^{abcd}	0.456	0.018

Means with different superscripts (a, b, c, d) in a row differ significantly (P ≤ 0.05) from each other

Renal function test, serum Ca and P level: The mean values of serum uric acid (mg/dl), serum creatinine, serum calcium and serum phosphorus are given in Table 4.

Serum calcium: A significant (P ≤ 0.05) effect on the average concentration of serum calcium was observed when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal. Significantly (P ≤ 0.05) higher serum calcium was noticed in T₅ followed by T₆ treatment group as compared to control.

Serum phosphorus. Significant (P ≤ 0.05) effects on the average concentration of serum phosphorus were observed when Japanese quail chicks were fed diet with different levels of *Moringa oleifera* leaf meal. Significantly (P ≤ 0.05) higher serum phosphorus was observed in T₄ followed by T₅ treatment group as compared to control.

Serum uric acid. Non-significant (P > 0.05) effects on average concentration of serum uric acid (mg/dl) were observed when Japanese quail was fed diet with different levels of *Moringa oleifera* leaf meal. This observation was similar with the result of Tijani *et al.*

(2016), who reported that uric acid contents were similar in birds fed 5%, 10% and 15% *Moringa* leaves treated diets.

Serum creatinine: Significant (P ≤ 0.05) effects on the average concentration of serum creatinine were observed when Japanese quail were fed diet with different levels of *Moringa oleifera* leaf meal. Significant (P ≤ 0.05) lower serum creatinine was observed in T₅ followed by T₆ treatment group respectively. Statistically similar serum creatinine were observed in T₁, T₃, T₄, and T₈ treatment groups respectively. *Moringa oleifera* is rich in flavonoids and carotenoids (β-carotene), which positively affect creatinine levels in the serum (Elkloub *et al.*, 2015). The findings are in accordance with the report of Castillo *et al.* (2018) who observed significantly (P ≤ 0.05) decreased serum creatinine with increasing levels (7, 14 and 21%) of MOL in the diets of Japanese quail. The creatinine values obtained were within the normal physiological range and are indicative of normal functioning of the kidneys (Hammad *et al.*, 2018).

Table 4: Average values of renal function test, serum Ca and P level (mg/dl) in Japanese quail chick at 6 weeks of age fed diets incorporated with *Moringa oleifera* leaf meal.

Attributes	Treatments/ groups								SEm	P-Value
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈		
Uric Acid	1.48±0.23	1.44±0.19	1.46±0.17	1.41±0.13	1.32±0.01	1.38±0.02	1.39±0.01	1.41±0.01	0.040	0.994
Creatinine	0.66±0.01 ^{ab}	0.67±0.01 ^a	0.64±0.01 ^{abc}	0.63±0.02 ^{abc}	0.57±0.01 ^d	0.59±0.01 ^{cd}	0.61±0.02 ^{bc}	0.64±0.01 ^{abc}	0.007	0.003
Serum calcium	8.22±0.05 ^b	8.28±0.03 ^b	8.32±0.09 ^b	9.06±0.35 ^b	10.20±0.47 ^a	9.15±0.44 ^b	8.98±0.33 ^b	8.29±0.11 ^b	0.159	0.002
Serum phosphorus	7.05±0.08 ^b	7.12±0.10 ^b	7.28±0.08 ^b	8.35±0.04 ^a	8.28±0.37 ^a	8.18±0.12 ^a	8.22±0.20 ^a	8.15±0.40 ^a	0.128	0.001

Means with different superscripts (a, b, c, d) in a row differ significantly (P ≤ 0.05) from each other

CONCLUSIONS

Based on the findings of the present study, it can be concluded that 3% *Moringa oleifera* leaf meal can be incorporated in feed for improvement of biochemical parameters of the Japanese quail.

FUTURE SCOPE

Similar type of work can be conducted in different species of poultry.

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Conflict of Interest. None.

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